Active Balancing of Power Inverters
H. Kwak, T. Hubing
Clemson Vehicular Electronics Laboratory

Abstract: Common-mode currents generated by power inverters and motor drivers are a significant source of conducted and radiated interference. It is theoretically possible to build power inverters that are perfectly balanced and therefore generate no interference and require no filtering. We are applying this concept to an existing motor driver to illustrate how effective and cost-efficient a balanced design can be.

Introduction
The fast switching that is an inherent part of efficient motor drives and power inverters produces a high amount of electrical noise. Imbalances in the switching circuitry, transmission path and load convert differential drive noise into common-mode currents that can be significant sources of broadband radiated emissions typically peaking around 30 - 60 MHz. These emissions can interfere with other electronic devices, especially devices that rely on wireless communications.

Approach
The most common method of dealing with this form of electromagnetic interference is to apply extensive common-mode filtering. However, this filtering adds significantly to the cost and weight of a motor driver or power inverter and contributes nothing to the overall functionality or efficiency.

A better approach is to actively enforce the electrical balance of the driver circuitry, while simultaneously compensating for imbalances in the transmission lines and load. Active balancing has the potential to drastically reduce electrical noise and to actually improve the overall efficiency of the power transfer. The potential cost and efficiency savings are roughly proportional to the power rating of the inverter.

Although the specific methods being evaluated are still proprietary, the idea is basically to ensure that the impedances of each phase to ground always sum to a constant value even though they are individually varying with time.

Summary
Clemson researchers are working with industry partners to develop active balancing techniques that will reduce the cost and improve the efficiency of a wide range of commercial and automotive power electronics.